U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE

HEARING CHARTER

Ongoing Problems and Future Plans for NOAA's Weather Satellites

November 16, 2005
10:00 a.m. to 12:00 p.m.
2318 Rayburn House Office Building

Purpose:

On November 16, 2005 at 10:00 a.m., the House Science Committee will hold a hearing about ongoing problems and future plans for the National Oceanic and Atmospheric Administration's (NOAA) key weather satellite program, the National Polar-orbiting Operational Environmental Satellite System program (NPOESS).

NPOESS is designed to provide critical weather information for NOAA and the Air Force, which are jointly managing the program. (The National Aeronautics and Space Administration (NASA), which provides technical assistance is also involved in program management, and other military services besides the Air Force will also use the data from NPOESS.) NPOESS will replace current NOAA and Air Force satellites, which are nearing the end of their useful lives. NPOESS is the most expensive and perhaps the most complex satellite procurement in NOAA's history.

The NPOESS program has been deeply troubled and is now running as much as $3 billion over budget and as many as three years behind schedule, creating a possible gap in satellite coverage (if existing satellites fail before NPOESS can replace them). NOAA and the Air Force recently replaced the lead program manager, and some of the contractors have also brought in new people to oversee the program. NOAA and the Air Force will soon decide how they are going to bring the program under control. The agencies do not seem to be considering any options that would require additional funding before Fiscal Year (FY) 2008, but waiting to spend more funds is likely to increase total program costs and delays.

The hearing is intended to review how the program went awry, why Congress was not given more timely and accurate information on the status of the program, and, most importantly, how the program should move forward.

The Committee plans to examine these overarching questions:

1. What is the current estimate of the cost and launch date for the first NPOESS satellite compared to the September 2003 baseline ($7.4 billion and November 2009) and when will an official new baseline be available?

2. What program options are being considered in response to the increased cost and schedule delays?

3. It is our understanding that no options are being considered that increase spending in Fiscal Year (FY) 2006 or FY 2007. Why is that the case? Will delaying action until FY 2008 increase the lifetime cost of the NPOESS program and increase the risk that the satellite will not be ready in time to perform its mission?

4. If the last satellite from the current NOAA polar series fails during launch or in orbit, then, given the schedule delays anticipated for NPOESS, there could be a 19- to 36-month gap in polar satellite coverage for NOAA. If a coverage gap were to occur, what are the implications for NOAA and DOD weather forecasting capabilities? What are the Federal government's contingency plans for a gap in polar satellite coverage?

Witnesses:

Vice Admiral Conrad C. Lautenbacher, Jr. (Ret.), Administrator of the National Oceanic and Atmospheric Administration.
Dr. Ronald M. Sega, Undersecretary of the Air Force.
Dr. Alexis Livanos, President of Northrop Grumman Space Technology.
Mr. David Powner, Director of Information Technology Management Issues, Government Accountability Office.

Background:

NPOESS: A new approach to weather satellite development

The federal government has traditionally launched separate weather satellites to serve military and civilian needs. The National Polar-orbiting Operational Environmental Satellite System (NPOESS), begun in 1994, is the first joint weather satellite program. The National Oceanic and Atmospheric Administration (NOAA) and the Department of Defense (DOD) together share the cost of developing the NPOESS satellites. The National Aeronautics and Space Administration (NASA) also supports the program primarily by overseeing the development of a small satellite, known as the NPP (for NPOESS Preparatory Project) designed to test some of the advanced sensors the NPOESS satellites will later carry, reducing the risk that these sensors will not work as expected.

The NPOESS satellites are designed to fly in an orbit around the Earth's poles. They complement other weather satellites that orbit the Earth at the equator (so-called geostationary satellites because they orbit at the same speed as the Earth rotates, and so appear to hover above a fixed position on the ground). As polar-orbiting satellites circle the Earth, they provide global coverage of weather and climate conditions.

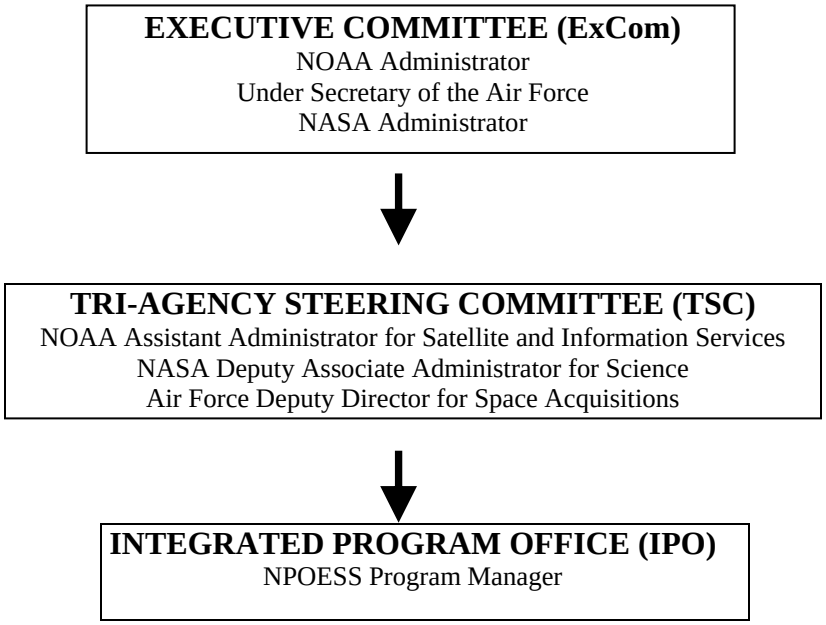
NPOESS satellites are being built to carry instruments, or sensors, to measure a number of meteorological features important to developing three- to seven-day weather forecasts and for

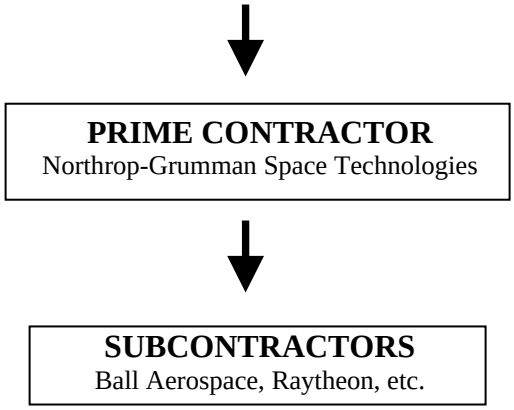
predicting severe weather, such as hurricanes. For example, some sensors are being developed to measure ocean winds to help predict El Nino and aid the military's operation of aircraft carriers. Others will measure soil moisture, which is important to agriculture and water resource managers. Aerosol detectors will help predict such aviation hazards as volcanic ash while helping the military predict whether it will be able to accurately spot its targets. Ocean-color sensors can track fish populations and ocean-borne pollution while helping the military sweep for mines. And as the events of the last few months have shown, improved accurate forecasts can help better predict hurricane paths, allowing emergency managers to target their efforts and preventing unnecessary coastal evacuations that can cost up to $1 million a mile. (For list of the 13 instruments to be carried on board NPOESS satellites see Appendix 1.)

The NPOESS program is supposed to produce six weather satellites, only three of which will be placed in orbit at any one time. The satellites will replace polar-orbiting weather satellites now being flown by the military (known as the Defense Meteorological Satellite Program, or DMSP satellites) and by NOAA (known as Polar Operational Environmental Satellites, or POES). The six satellites, referred to as C-1 through C-6, are being developed by Northrop-Grumman Space Technology under a contract managed jointly by DOD and NOAA through an office called the Integrated Program Office (IPO). (For an organizational chart showing the management structure of the NPOESS program, see Figure 1.)

The NPP test satellite is being developed by Ball Aerospace and Technologies Corporation under a contract managed by NASA rather than by the IPO. NPP will allow weather and climate modelers to determine how best to make use of the voluminous advanced data that NPOESS satellites will provide. In the past, it has taken up to two years for weather forecasters to learn how to adapt their models to use data from new NOAA satellites. Because NPP will provide NOAA with 93 percent of the data that NPOESS satellites are expected to deliver, the test satellite will allow users to take full advantage of NPOESS almost immediately after launch.

Figure 1. NPOESS Program's Management Structure.





A History of Problems with NPOESS

NPOESS has a history of budget and technical problems (see the hearing by the Science Committee's Subcommittee on Environment, Technology and Standards in July 2003, available at http://www.house.gov/science/). When first conceived in 1994, NPOESS was expected to cost $6.5 billion, a savings of $1.8 billion compared to the cost of separately developing new satellite systems for military and civilian use. The NPP test satellite was originally expected to be ready for launch in May 2006, while the first operational NPOESS, the C-1 satellite, was to be available for launch in June 2008.

The government and contractors drew up a new cost estimate and schedule for NPOESS (known as a "rebaselining") early last year to take into account funding cutbacks in FY 2003 (by Congress) and FY 2004 (by the Administration). Under the new baseline, the total expected cost of the program rose by $900 million (to $7.4 billion) and the schedule was delayed by several months: NPP would be launched in October 2006 and NPOESS C-1 would launch in February 2009.

In November 2004, major technical and engineering problems emerged with one of the key sensors, known as VIIRS (pronounced like "veers," the instrument is a type of infrared camera used to collect images of clouds and to probe sea surface temperature, an important aspect of hurricane prediction). NOAA said at the time that the problems with VIIRS required a further delay in schedule – this time, limited to the NPP satellite – of more than a year (to April 2008). In response to the problems with the sensor, Raytheon, the subcontractor building VIIRS, fired its entire technical team working on the instrument and put new staff on the task. (VIIRS is not the only sensor on NPOESS that is having problems, but its troubles have been the most problematic thus far.)

NOAA and IPO officials stated publicly at that time that the effect of the problems were limited to NPP and would not delay the launches of the other satellites or significantly increase the cost of the program as a whole. IPO officials repeated that message to Committee staff at a briefing on March 23, 2005.

But earlier in March, NPOESS contractor Northrop-Grumman told IPO officials that delays in NPOESS might be required. And on March 31, Northrop-Grumman gave a comprehensive briefing to IPO officials concluding that problems with the NPOESS satellite program had grown so severe that meeting the rebaselined costs and schedule was unlikely. (NOAA never reported this information to the Congress, although rumors began circulating at the time. Some of the details have emerged from government documents requested by the Science Committee.)

Beginning in April, Committee staff requested briefings from NOAA on the problems the program was rumored to be facing, but NOAA officials delayed scheduling any briefings, and cancelled one briefing after it had been scheduled. Northrop-Grumman, too, cancelled a briefing for Committee staff soon after it had been scheduled. The Committee was unable to get a briefing on the status of the program until July 28, when, in response to demands by the Chairmen and Ranking Members of the Science Committee and its Subcommittee on Environment, Technology and Standards, the Administrator of NOAA met with the four Members.

On August 5, NOAA and IPO officials briefed Committee staff in more detail about the problems plaguing the satellite program. At that meeting, IPO officials told Committee staff that the IPO did not become aware of the severity of NPOESS' problems until May – in reality, almost two months after the IPO had received Northrop-Grumman's briefing, according to documents provided to the Committee.

The Committee then sent a letter to NOAA (dated August 12) requesting documents relating to the problems with the NPOESS and NPP programs and when government officials learned of them. Initially, NOAA responded only partially to the request. On October 20, the Committee sent another letter following up on the first. Last Thursday, NOAA began providing the additional documents and, while it has yet to comply completely with the request, NOAA now seems to be cooperating with the Committee's investigation.

What Went Wrong

In retrospect at least, it seems clear that the government and the contractor did not fully appreciate the complexities inherent in building VIIRS. These difficulties should have been noted at the Critical Design Review, a key step in moving ahead with a satellite, which for VIIRS occurred in early 2002. Northrop-Grumman now says that it had assumed that because some aspects of VIIRS were based on existing instruments, developing the sensor as a whole would be simpler than it has turned out to be. Raytheon contends that it was aware of the aspects of VIIRS that could cause problems during development, but clearly its bid did not accommodate the problems that were to occur. Both contractors agree that their bids, following what they say is standard practice, had about a 50 percent confidence level – that is, the contractors assumed there would be a 50 percent chance that their cost estimates would be accurate, and they provided reserve funds for the project accordingly. Those reserves have proven to be inadequate and have already been entirely consumed. The agencies and the contractors are now getting ready to rebaseline the program again, and the agencies have said they want the new cost estimates to be based, in effect, on an 80 percent confidence level.

Industry officials appear to agree now that that the government should have required more proof that the design for building the VIIRS instrument was sound when it conducted the instrument's Critical Design Review, the stage in the development of VIIRS when the government gave the final go-ahead to build a major piece of equipment.

In addition, problems occurred with VIIRS because the initial technical team working on the instrument for Raytheon had never worked on an operational satellite before, having conducted all their work building research satellites. But operational satellite development must be managed much more strictly than one-of-a-kind research satellites. Any schedule slips that may arise in the development of research satellites merely delay the research to be done. But schedule slips in operational weather satellites can have much more serious consequences (see below for more details).

Options for NPOESS

When Northrop-Grumman notified the government in March 2005 that the NPOESS satellites could no longer be developed on time and within budget, the government's leading officials overseeing the NPOESS program, the agencies began another review of the program.

The top officials in charge of the project, the ExCom, met in August and October to consider options, but has yet to make a final decision on how to move forward with the satellite program. It is scheduled to meet again next Tuesday.

In general, the government has several options: it can dedicate more money to the program to pay for additional people and work necessary to solve the satellite's technical problems; it can stretch the production schedule to give the existing workforce time to solve the problems; it can scale back the satellite's capabilities by eliminating individual sensors or other aspects of the program to free up money and workforce to focus on the technical problems; or any combination of the three.

According to documents NOAA has provided, the ExCom has ruled out eliminating NPP or one of the six NPOESS satellites. It also has ruled out providing any additional money to NPOESS for fiscal years 2006 and 2007. It is unclear why the ExCom is unwilling to seek more funding before FY 2008. Internal Pentagon rules make it more difficult for the Air Force to shift funds among programs and the current Air Force satellites have more years of service left than NOAA's do.

Instead of providing additional funding, the ExCom plans to slow down the development of some of NPOESS' other instruments to pay for the increased work necessary to fix the problems with VIIRS. In addition, the ExCom is considering delaying the delivery dates of some sensors and has already eliminated at least one other (the Landsat imager) altogether. (The Landsat instrument will probably be flown separately; a decision is pending. Previous Landsat instruments flew separately, but this one was moved to NPOESS to save money, among other reasons.)

Of the options the ExCom is considering, all would delay the availability of NPP by at least 30 months (to April 2009), and all would delay the availability of the NPOESS C-1 satellite by at least 36 months (to sometime in 2012).

Implications of the Options for NPOESS

A delay in the delivery of NPOESS could lead to a gap in coverage of the U.S. by civilian polar-orbiting weather satellites. NOAA plans to launch the last its POES polar-orbiting satellite in December 2007. It is NOAA's policy always to have a replacement satellite on hand to cover the possibility that the original will fail upon launch. Originally, NPOESS C-1 was to be available in case the last POES satellite failed. But under the options the ExCom now has under consideration, the new satellite will not be ready until 50 months later (because of previous delays as well as the current one), potentially exposing the U.S. to a gap in civilian coverage of more than four years.

Complicating the situation further, as it finished building this last POES satellite in 2003, the contractor, Lockheed-Martin dropped it on the floor of the assembly plant, causing significant damage (see below for more information). Lockheed-Martin is repairing the satellite's components with spare parts, but has yet to fully test the satellite. As a result, it is unknown whether the fall has increased the likelihood that the satellite will fail.

The military expects to be able to make its satellites last well past the 2012 NPOESS launch date. But the military satellites do not provide the complete global coverage required by NOAA. Also, the military does use some data that are available only from NOAA's satellites. It is unclear how the potential gap could affect the military.

Also unclear is whether NOAA could rely on European weather satellites because it is not certain that the data produced by the sensors on European satellites are compatible with U.S. weather forecast models, or that these satellites would even be available.

To minimize the potential consequences of such a gap in coverage, the ExCom reportedly is considering bolstering the capabilities of the NPP satellite. Rather than simply providing a platform to test the crucial sensors planned to fly aboard NPOESS satellites later, the NPP satellite could be made to operate more like an operational satellite, albeit with a limited suite of instruments. It is unclear how much more expensive such a modification would be. Furthermore, because in the past it has taken up to two years for weather forecasters to learn how to adapt their models to use data from new instruments, it is unclear how long it could take for NPP to be useful for weather prediction.

Fixing the problems facing NPOESS will increase the lifetime costs of the satellite program by at least $1 billion, and perhaps as much as $3 billion. Part of the increase in cost is due strictly to the ExCom's decision not to spend any additional money in FY 2006 and 2007 because extending the duration of a program that employs a large workforce necessarily increases labor costs. According to Northrop-Grumman, providing additional funding in fiscal years 2006 and 2007 could significantly reduce the lifetime cost of the NPOESS program. NOAA officials have

said that they expect to increase funding for the program in FY 2008, but it is not clear whether the budget climate then will be more favorable to making additional funding available.

Nunn-McCurdy Notification

The NPOESS contract follows DOD acquisition procedures. As a result, it is subject to the Nunn-McCurdy provisions of the DOD acquisition regulatory process (10 U.S.C 2433). The law establishes reporting requirements in cases where cost overruns occur in major defense acquisition programs. If a program manager has reasonable cause to believe that costs will increase more than 15 percent over the most recent baseline estimate, DOD must notify Congress. If costs increase more than 25 percent, the Secretary of Defense (or the Secretary of the appropriate branch of the military) has 30 days to certify the program, otherwise no funds may be obligating for the program. Certification requires a written justification that the program is essential to the nation's security, that there are no alternatives to the program, that the new cost estimates are reasonable, and that the management structure is adequate.

On September 29, 2005, the Secretary of the Air Force notified Congress that the NPOESS program would exceed the 15 percent Nunn-McCurdy notification threshold (meaning that acquisition costs would increase by at least $1 billion over the program's most recent cost estimate of $7.4 billion). The Air Force initiated an Independent Program Assessment to review the technical and cost baselines of the program and to develop options for moving forward. (Documents prepared by the Independent Program Assessment, which is being conducted by the Aerospace Corporation, are the source of much of the cost and option information in this charter. The Committee received the documents in response to its recent request.) The final results of the Assessment are expected at the ExCom meeting next week.

Other Satellite Problems

This is not the first time a NOAA satellite program has experienced major cost overruns, technical problems or management issues. In September 2003, lax government oversight of, and lax contractor oversight by Lockheed-Martin resulted in a major accident in the POES-production facility. (The program is overseen by NASA under an agreement with NOAA.) The final satellite in the POES series fell off of its platform because Lockheed-Martin employees did not follow standard procedures and check that all the bolts were in place before moving the satellite. During the late 1980s, another major satellite acquisition program at NOAA, GOES-NEXT, ran $1.4 billion over budget and five years behind schedule due to a lack of technical planning and program development delays. GOES-NEXT's problems were similar to those that NPOESS is experiencing now. As a result of those problems, NOAA was forced to rely on a single GOES satellite from 1989 through 1992, when normally it uses two satellites. Had the one satellite failed, NOAA would have been unable track severe weather in real time or provide continuous weather coverage of the United States. Delays in NPOESS could result in the nation running similar risks.

Questions for Witnesses

The witnesses were asked to address the following questions in their testimony:

Vice Admiral Conrad C. Lautenbacher, Jr. (Ret.)

1. What is your current estimate of the cost and launch date for the first NPOESS satellite compared to the September 2003 baseline ($7.4 billion and November 2009)? What steps need to be taken to firm up the cost and schedule estimate and when will an official new baseline be available?
2. What program options are being considered in response to the increased cost and schedule delays? Do any of these options involve scaling back the capability of the NPOESS satellite? Would such scaling back affect the plans of other agencies to fly sensors on NPOESS?
3. It is our understanding that no options are being considered that increase spending in Fiscal Year (FY) 2006 or FY 2007. Why is that the case? Will delaying action until FY 2008 increase the lifetime cost of the NPOESS program and increase the risk that the satellite will not be ready in time to perform its mission? Is the decision to not increase spending driven purely by near-term Federal budget constraints? If so, why is NOAA assuming that funding will be more available in FY 2008?
4. If the last satellite from the current NOAA polar series fails during launch or in orbit, then, given the schedule delays anticipated for NPOESS, there could be a 19- to 36-month gap in polar satellite coverage for NOAA. If a coverage gap were to occur, what are the implications for NOAA weather forecasting capabilities? What are NOAA's contingency plans for a gap in polar satellite coverage?

Dr. Ronald M. Sega

1. What is your current estimate of the cost and launch date for the first NPOESS satellite compared to the September 2003 baseline ($7.4 billion and November 2009)? What steps need to be taken to firm up the cost and schedule estimate and when will an official new baseline be available?
2. What program options are being considered in response to the increased cost and schedule delays? Do any of these options involve scaling back the capability of the NPOESS satellite? Would such scaling back affect the plans of other agencies to fly sensors on NPOESS?
3. It is our understanding that no options are being considered that increase spending in Fiscal Year (FY) 2006 or FY 2007. Why is that the case? Will delaying action until FY 2008 increase the lifetime cost of the NPOESS program and increase the risk that the satellite will not be ready in time to perform its mission? Is the decision to not increase spending driven purely by near-term Federal budget constraints? If so, why is the Air Force assuming that funding will be more available in FY 2008?
4. If the last satellite from the current NOAA polar series fails during launch or in orbit, then, given the schedule delays anticipated for NPOESS, there could be a 19- to 36-month gap in polar satellite coverage for NOAA. If a coverage gap in NOAA satellites were to occur, what are the implications for the Air Force and/or the Department of Defense weather forecasting capabilities? What are the contingency plans for a gap in polar satellite coverage? Is the Air Force's capability to forecast weather as vulnerable to delays in NPOESS as NOAA's is?

Mr. David Powner

1. What is your current estimate of the cost and launch date for the first NPOESS satellite compared to the September 2003 baseline ($7.4 billion and November 2009)?
2. What program options should be considered in response to the increased cost and schedule delays?
3. It is our understanding that no options are being considered that increase spending in Fiscal Year (FY) 2006 or FY 2007. Will delaying action until FY 2008 increase the lifetime cost of the NPOESS program and increase the risk that the satellite will not be ready in time to perform its mission?
4. What are the major technical and program management risks still facing the NPOESS program?

Dr. Alexis Livanos

1. What is your current estimate of the cost and launch date for the first NPOESS satellite compared to the September 2003 baseline ($7.4 billion and November 2009)? What steps need to be taken to firm up the cost and schedule estimate and when will an official new baseline be available?
2. What is Northrop-Grumman Space Technology (NGST) doing to address the technical problems, cost overruns and schedule delays in the NPOESS program? In particular, what changes has the company implemented or will it implement in its oversight of subcontractors to address the technical problems, cost overruns and schedule delays in the NPOESS program?
3. Have you recommended NPOESS program options to the Federal government in response to the cost increases and schedule delays? If so, what are those options? Are there other major options you think should be considered by the government?
4. It is our understanding that the Federal government is not considering any options that increase spending in Fiscal Year (FY) 2006 or FY 2007. What are the pros and cons of waiting until FY 2008 to provide additional funding to the NPOESS program? If Congress provided additional funding in FY 2006 or FY 2007, what could be accomplished to minimize lifetime cost increases and schedule delays?

Appendix 1: NPOESS Instrument Definition and Status (* indicates an NPP sensor)

NPOESS Instrument (Contractor**)**	**Acronym meaning**	**Description**	**Status as of November 2005**
VIIRS* (Raytheon)	Visible Infrared Imager Radiometer Suite	Visible and infrared imager for imaging clouds, sea surface temperature, etc. Upgrade of a NASA sensor, MODIS, and current POES sensor, AVHRR.	Major technical problems in September 2004 led to entire team being fired. Delivery will be delayed at least 18 months until April 2008.
CrIS* (ITT)	Cross-track Infrared Sounder	Provides high resolution atmospheric temperature and moisture profiles for long-range weather prediction.	Will be ready for integration onto NPP spacecraft in early 2006.
ATMS* (Northrop-Grumman thru a NASA contract)	Advanced Technology Microwave Sounder	Microwave sounder that is a companion to CrIS. Together CrIS and ATMS combine three old NASA sensors.	Ready to ship for integration onto NPP spacecraft.
OMPS* (Ball)	Ozone Mapping and Profiler Suite	Ozone and wind prediction.	Ready for integration onto NPP spacecraft in fall 2006. Still facing some technical problems.
CMIS (Boeing)	Conical Scanning Microwave Imager/Sounder	Microwave imager to collect data about atmospheric temperature and moisture, clouds, and sea surface winds. Based on old NASA satellites known as TRMM and Windsat.	Facing major delays due to funding restraints.
GPSOS (Saab Ericsson)	Global Positioning System Occultation Sensor	GPS	On schedule
ADCS (Northop-Grumman)	Advanced Data Collection System	Data collection	On schedule
SESS (Ball)	Space Environment Sensor Suite	Measures for disturbances from solar flares, which can disrupt communications systems and electric power grids	On schedule
APS (Raytheon)	Aerosol Polarimetry Sensor	Aerosols and climate change	On schedule
SARSAT	Search and Rescue Satellite-Aided Tracking	Search and rescue	On schedule
TSIS (Univ. Colorado)	Total Solar Irradiance Sensor	Solar irradiance to understand climate change	On schedule
ERBS (Northrop-Grumman)	Earth Radiation Budget Suite	Earth radiation to understand climate change	On schedule
ALT (Alcatel)	Radar Altimeter	Ocean currents and depths	On schedule
SS		Survivability monitor	On schedule

Appendix 2: Acronym list

NPOESS: National Polar-orbiting Operational Environmental Satellite System

C-1 to C-6: The six NPOESS satellites

NPP: NPOESS Preparatory Project

POES N: Polar Operational Environmental Satellite N, current NOAA polar satellite

POES N': Polar Operational Environmental Satellite N', last of current NOAA polar satellites planned for launch in December 2007

DMSP: Defense Meteorological Satellite Program

F17 to F20: The remaining DMSP satellites

IPO: Integrated Program Office

ExCom: NPOESS Executive Committee (Air Force, NOAA, and NASA)